

Whereas I claim:

1. A device to convert energy by displacing fluid, the device comprising:

an outer rotor adapted to rotate about a first axis of  
rotation and comprising:

a plurality of fins each comprising a first surface  
and a second surface that partially define a  
chamber region interposed thereinbetween  
where a first fin and a second fin are members  
of the said plurality of fins and are adjacent to  
each other, and

a first reference radius extends through the first fin  
and a second reference radius extends through  
the second fin, a first surface of the said first fin  
is a first defined distance from the said first  
reference radius with respects to the radial  
location along the said first reference radius,  
and a second surface of the said second fin is  
a second defined distance from the said  
second reference radius with respects to the  
radial location along the said second reference  
radius, and

the number of the chambers indicated by variable  
X,

an outer reference dimension circle that is  
concentric with the said first axis of rotation of  
the said outer rotor and the outer reference  
dimension circle having a radius  $r_o$ ;

a plurality of inner rotors each adapted to rotate about a  
second set of axes of rotation and each inner rotor

comprising an inner reference circle that is concentric  
with the axis of rotation of each inner rotor and each  
inner reference circle intersecting the outer reference  
circle of the said outer rotor at an intersect point  
5 where the velocity of the inner rotor and outer rotor  
are the same at the said intersect points, the inner  
reference circles each having a radius  $r_i$ , the inner  
rotors further each comprising a plurality of legs the  
number of said legs for each inner rotor is indicated by  
10 variable  $n$  where a first leg that is a member of said  
legs comprises a foot region the foot region  
comprising;

a heel region comprising a first reference point that  
is adapted to rotate with said first reference  
15 circle where said first reference point is non  
constant perpendicular distance from the said  
first reference radius of the outer reference  
circle with respects to rotation of the inner and  
the outer rotor, and the heel region further  
20 comprising a first engagement surface that is a  
first defined distance from the said first point  
where the said first defined distance of the heel  
region and the first defined distance of the first  
surface of the said first fin are collinear and  
25 their sum is non constant with respects to  
rotation of the inner rotor and the outer rotor,  
a toe region comprising a second reference point  
that is positioned on said inner reference  
dimension circle, a second engagement  
30 surface that is a second defined distance from

the reference point where the second defined distance of the toe region and the second defined distance of the second surface of the second fin are collinear and their sum is non constant with respects to rotation of the inner rotor and outer rotor,

a casing having an inner chamber region that is adapted to house said outer rotor and allow the outer rotor to rotate therein, the casing comprising;

a fluid entrance system comprising a duct to communicate with the chamber region of the said outer rotor,

an interior cavity adapted to house the said inner rotors and allow the inner rotors to rotate therein,

whereas the said variables  $\alpha$ ,  $\beta$ ,  $r_i$ ,  $r_o$  are constrained by the equation  $\alpha / \beta = r_i / r_o$ , the foot region of the said first leg is adapted to engage the chamber region where the first engagement surface of said heel region engages the said first surface of a first fin and the said second engagement surface of the said toe region of the said first foot is adapted to engage the second surface of a second fin to form a sealed operating chamber where rotation of the said first rotor and the said rotor causes displacement of fluid in the sealed operating chamber.

2. The device as recited in claim 1 where the said porting of the casing is adapted to allow non compressible fluid to enter the said chamber region and the casing comprising a

discharge port in communication with the sealed operating chamber as the volume of fluid is displaced.

3. The device as recited in claim 1 where ratio of  $r_1 / r_0$  is less than  $\frac{1}{2}$ .

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4. The device as recited in claim 1 where the casing comprises a gas expansion region and a gas inlet port that is in communication with a gas expansion chamber that is defined by first and second surfaces of two adjacent fins and the said first foot where the chamber is adapted to receive expanding gas that applies a torque to the outer rotor.

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5. The device as recited in claim 4 where ratio of  $r_1 / r_0$  is less than  $\frac{1}{2}$ .

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6. The device as recited in claim 1 where the casing comprises a gas entrance channel that is adapted to receive a gas and the sealed operating chamber operates as a gas compression chamber that is adapted to compress gas and be discharged through an exit channel.

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7. The device as recited in claim 1 where ratio of  $r_1 / r_0$  is an integer value.

8. The device as recite in claim 6 where the exit channel has an adjustment system to adjust the compression ratio of the compressed gas.

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9. The device as recite in claim 6 where the gas is air.

10. The device as recited in claim 6 further having a second expansion device that comprises:

a second outer rotor adapted to rotate about a first axis of rotation and the second outer rotor comprising:

- 5 a plurality of fins each comprising a first surface and a second surface that partially define a chamber region interposed thereinbetween where a first fin and a second fin are members of the said plurality of fins and are adjacent to
- 10 each other, and
- a first reference radius extends through the first fin and a second reference radius extends through the second fin, a first surface of the said first fin is a first defined distance from the said first
- 15 reference radius with respects to the radial location along the said first reference radius, and a second surface of the said second fin is a second defined distance from the said second reference radius with respects to the
- 20 radial location along the said second reference radius, and
- the number of the chambers indicated by variable  $X$ ,
- an outer reference dimension circle that is
- 25 concentric with the said first axis of rotation of the said outer rotor and the outer reference dimension circle having a radius  $r_o$ ;
- a second set of plurality of inner rotors each adapted to rotate about a second set of axes of rotation and each
- 30 inner rotor comprising an inner reference circle that is

concentric with the axis of rotation of each inner rotor  
and each inner reference circle intersecting the outer  
reference circle of the said outer rotor at an intersect  
point where the velocity of the inner rotor and outer  
rotor are the same at the said intersect points, the  
inner reference circles each having a radius  $r_i$ , the  
inner rotors further each comprising a plurality of legs  
the number of said legs for each inner rotor is  
indicated by variable  $n$  where a first leg that is a  
member of said legs comprises a foot region the foot  
region comprising;

a heel region comprising a first reference point that  
is adapted to rotate with said inner reference  
circle where said first reference point is non  
constant perpendicular distance from the said  
first reference radius of the outer reference  
circle with respects to rotation of the inner and  
the outer rotor, and the heel region further  
comprising a first engagement surface that is a  
first defined distance from the said first point  
where the said first defined distance of the heel  
region and the first defined distance of the first  
surface of the said first fin are collinear and  
their sum is non constant with respects to  
rotation of the inner rotor and the outer rotor,  
a toe region comprising a second reference point  
that is positioned on said inner reference  
dimension circle, a second engagement  
surface that is a second defined distance from  
the reference point where the second defined

distance of the toe region and the second defined distance of the second surface of the second fin are collinear and their sum is non constant with respects to rotation of the inner rotor and outer rotor.

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11. The device as recited in claim 10 further comprising:

a combustion chamber where air is directed from the said exit channel to an inlet region of the said combustion chamber, The combustion chamber further comprising an exit passage that is in communication with an expansion passage.

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12. The device as recited in claim 11 where the exiting gas from the expansion passage is used for output thrust work.

13. The device as recited in claim 11 where the casing comprises a gas expansion region and a gas inlet port that is in communication with a gas expansion chamber that is defined by first and second surfaces of two adjacent fins and the said first foot where the chamber is adapted to receive expanding gas that applies a torque to the outer rotor.

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14. The device as recited in claim 13 where the torque on the outer rotor is used to compress air to feed the said combustor.

15. The device as recited in claim 13 where a portion of the output gas from the combustor is directed to drive an expansion chamber of the said second compression device.

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16. The device as recited in claim 10 where the second expansion device is comprises a shaft that is connected to

the outer rotor and the second outer rotor where the axis of rotation of the first rotor and second rotor are collinear.

17. A device to convert energy by displacing fluid, the device comprising:

5           an outer rotor adapted to rotate about a first axis of rotation and comprising:

          a plurality of fins each comprising a first surface and a second surface that partially define a chamber region interposed thereinbetween  
10           where a first fin and a second fin are members of the said plurality of fins and are adjacent to each other, and

          a first reference radius extends through the first fin and a second reference radius extends through  
15           the second fin, a first surface of the said first fin is a first defined distance from the said first reference radius with respects to the radial location along the said first reference radius,  
          and a second surface of the said second fin is  
20           a second defined distance from the said second reference radius with respects to the radial location along the said second reference radius, and

          the number of the chambers indicated by variable

25            $X$ ,

          an outer reference dimension circle that is concentric with the said first axis of rotation of the said outer rotor and the outer reference dimension circle having a radius  $r_0$ ;



an inner rotor adapted to rotate about a second axis of rotation and the inner rotor comprising an inner reference circle that is concentric with the second axis of rotation and the inner reference circle intersecting the outer reference circle of the said outer rotor at an intersect point where the velocity of the inner rotor and outer rotor are the same at the said intersect points, the inner reference circle having a radius  $r_i$ , the inner rotor further comprising a plurality of legs the number of said legs for each inner rotor is indicated by variable  $n$  where a first leg that is a member of said legs comprises a foot region the foot region comprising;

a heel region comprising a first reference point that is adapted to rotate with the inner reference circle where said first reference point is non constant perpendicular distance from the said first reference radius of the outer reference circle with respects to rotation of the inner and the outer rotor, and the heel region further comprising a first engagement surface that is a first defined distance from the said first point where the said first defined distance of the heel region and the first defined distance of the first surface of the said first fin are collinear and their sum is non constant with respects to rotation of the inner rotor and the outer rotor, a toe region comprising a second reference point that is positioned on said inner reference dimension circle, a second engagement

surface that is a second defined distance from the reference point where the second defined distance of the toe region and the second defined distance of the second surface of the second fin are collinear and their sum is non constant with respects to rotation of the inner rotor and outer rotor,

a casing having an inner chamber region that is adapted to house said outer rotor and allow the outer rotor to rotate therein, the casing comprising;

a fluid entrance system comprising a duct to communicate with the chamber region of the said outer rotor,

an interior cavity adapted to house the said inner rotors and allow the inner rotors to rotate therein,

whereas the said variables  $\alpha$ ,  $\beta$ ,  $r_i$ ,  $r_o$  are constrained by the equation  $\alpha / \beta = r_i / r_o$ , the foot region of the said first leg is adapted to engage the chamber region where the first engagement surface of said heel region engages the said first surface of a first fin and the said second engagement surface of the said toe region of the said first foot is adapted to engage the second surface of a second fin to form a sealed operating chamber where rotation of the said first rotor and the said rotor causes displacement of fluid in the sealed operating chamber.

18. The device as recited in claim 17 where the said sealed chamber is maintained for five degrees of rotation of the inner rotor.
- 5 19. The device as recited in claim 17 where the said sealed chamber is maintained for fifteen degrees of rotation of the inner rotor.
20. The device as recited in claim 17 where the outer rotor is adapted to receive torque and the said sealed chamber is adapted to compress gas.
- 10 21. The device as recited in claim 17 where the tangential distance between the said first surface faces second surface of the two adjacent fins converge with respects to the traveling radial inward.
22. The device as recited in claim 17 where the tangential distance between the said first surface faces second surface of the two adjacent fins is not constant.
- 15 23. A device to convert energy by displacing fluid, the device comprising:
- 20 an outer rotor adapted to rotate about a first axis of rotation and comprising a plurality of fins each comprising a first surface and a second surface that partially define a chamber region interposed thereinbetween where a first fin and a second fin are members of the said plurality of fins and are adjacent
- 25 to each other, and a first reference radius extends through the first fin and a second reference radius extends through the second fin, a first surface of the

said first fin and a second surface of the said second fin, and the number of the chambers indicated by variable  $\square$ , the outer rotor further comprising an outer reference dimension circle that is concentric with the said first axis of rotation of the said outer rotor and the outer reference dimension circle having a radius  $r_o$ ;

a plurality of inner rotors adapted to rotate about a set of second axes of rotation where each inner rotor comprises an inner reference circle that is concentric with the second axis of rotation of the inner rotor and intersecting the outer reference circle of the said outer rotor at an intersect point where the velocity of the inner rotor and outer rotor are the same at the said intersect point, the inner reference circle having a radius  $r_i$ , the inner rotors further each comprise a plurality of legs the number of said legs is indicated by variable  $\square$  where a first leg that is a member of said legs comprises a foot region the foot region comprising;

a radially outward surface;

a heel region comprising a first reference point that is adapted to rotate with the inner reference circle where said first reference point is non constant perpendicular distance from the said first reference radius of the outer reference circle with respects to rotation of the inner and the outer rotor, and the heel region further comprising a first engagement surface adapted to engage the first surface of the said first fin,

a toe region comprising a second reference point  
that is positioned on said inner reference  
dimension circle, a second engagement  
surface that is adapted to engage the second  
5 surface of the second fin,

a casing having an inner chamber region that is adapted  
to house said outer rotor and allow the outer rotor to  
rotate therein, the casing comprising;

a fluid entrance system comprising a duct to  
10 communicate with the chamber region of the  
said outer rotor,  
an interior cavity adapted to house the said inner  
rotor,

whereas the said variables  $\alpha$ ,  $\beta$ ,  $r_i$ ,  $r_o$  are constrained by  
15 the equation  $\alpha / \beta = r_i / r_o$ , the foot region of the said  
first leg is adapted to engage the chamber region  
where the first engagement surface of said heel region  
engages the said first surface of a first fin and the said  
second engagement surface of the said toe region of  
20 the said first foot is adapted to engage the second  
surface of a second fin to form a sealed operating  
chamber where rotation of the said first rotor and the  
said rotor causes displacement of fluid in the sealed  
operating chamber a finite range of rotation.

- 25 24. The device as recited in claim 23 where the said porting of  
the casing is adapted to allow non compressible fluid to  
enter the said chamber region and the casing comprising a  
discharge port in communication with the sealed operating  
chamber as the volume of fluid is displaced.

25. The device as recited in claim 23 where ratio of  $r_i / r_o$  is less than  $\frac{1}{2}$ .
- 5 26. The device as recited in claim 23 where the casing comprises a gas expansion region and a gas inlet port that is in communication with a gas expansion chamber that is defined by first and second surfaces of two adjacent fins and the said first foot where the chamber is adapted to receive expanding gas that applies a torque to the outer rotor.
- 10 27. The device as recited in claim 25 where ratio of  $r_i / r_o$  is an integer value.
28. The device as recited in claim 26 where ratio of  $r_i / r_o$  is less than  $\frac{1}{2}$ .
- 15 29. The device as recited in claim 23 where the casing comprises a gas entrance channel that is adapted to receive a gas and the sealed operating chamber operates as a gas compression chamber that is adapted to compress gas and be discharged through an exit channel.
- 20 30. The device as recite in claim 29 where the exit channel has an adjustment system to adjust the compression ratio of the compressed gas.
31. A device to convert energy by displacing fluid, the device comprising:
- 25 an inner rotor adapted to rotate about a second axis of rotation where the inner rotor comprises an inner reference circle that is concentric with the second axis of rotation of the inner rotor the inner reference circle

having a radius  $r_i$ , the inner rotor further comprise a plurality of legs where a first leg that is a member of said legs comprises a foot region the foot region comprising;

- 5                   a radially outward surface;
- a heel region comprising a first reference point that is positioned on a distance defined as  $Rip_h$  from the second axis at a rotational position  $\theta_h$  and the heel region further comprising a first engagement surface that is an arc distance  $r_h$  from the said first reference point,
- 10                   a toe region comprising a second reference point that is positioned a distance defined as  $Rip_t$  from the said second axis at a rotational position  $\theta_t$ , a second engagement surface that is a radius distance  $r_t$  from the said second reference point,
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an outer rotor adapted to rotate about a first axis of rotation and comprising an outer reference dimension circle that is concentric with the said first axis of rotation of the said outer rotor and the outer reference dimension circle having a radius  $r_o$  and the outer rotor comprising;

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- a first and second fin each comprising a first reference radius at a rotational location  $\theta_o$  that extends through the first fin, a first surface of the said first fin a distance defined by  $gap_h$  from the said first engagement surface and having orthogonal coordinates  $Xf_h$ ,  $Yf_h$  from
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an origin point located on said first reference  
radius where  $Xf_h$  and  $Yf_h$  are defined by

$$\begin{aligned} Xf_h &:= (\sin(\theta_h) Rip_h - \sin(\theta_o) Ro) \cos(\theta_o) \\ &+ (-\cos(\theta_h) Rip_h - ro + ri + \cos(\theta_o) Ro) \sin(\theta_o) - r_h - gap_h \\ Yf_h &:= (-\cos(\theta_h) Rip_h - ro + ri + \cos(\theta_o) Ro) \cos(\theta_o) \\ &- (\sin(\theta_h) Rip_h - \sin(\theta_o) Ro) \sin(\theta_o) \end{aligned} ;$$

5 a second surface defined by orthogonal  
coordinates  $Xf_t$  and  $Yf_t$  from said origin  
where the distance between the said second  
surface and the second engagement surface is  
defined by distance,  $gap_t$  where the values  
10  $Xf_t$  and  $Yf_t$  are defined by

$$\begin{aligned} Xf_t &:= (\sin(\theta_t) Rip_t - \sin(\theta_o) Ro) \cos(\theta_o) \\ &+ (-\cos(\theta_t) Rip_t - ro + ri + \cos(\theta_o) Ro) \sin(\theta_o) + r_t + gap_t \\ Yf_t &:= (-\cos(\theta_t) Rip_t - ro + ri + \cos(\theta_o) Ro) \cos(\theta_o) \\ &- (\sin(\theta_t) Rip_t - \sin(\theta_o) Ro) \sin(\theta_o) \end{aligned} ;$$

a casing having an inner chamber region that is adapted  
to house said outer rotor and allow the outer rotor to  
15 rotate therein, the casing comprising;

a fluid entrance system comprising a duct to  
communicate with the chamber region of the  
said outer rotor,

20 an interior cavity adapted to house the said inner  
rotor,

whereas the  $\theta_o$  changes at a ratio of  $r_i / r_o$  of the  $\theta_i$  value  
and the foot region of the said first leg is adapted to  
engage the chamber region defined between the said  
first and second fin where the first engagement  
25 surface of said heel region is adapted to engage the  
said first surface of the first fin and the said second



engagement surface of the said toe region of the said first foot is adapted to engage the second surface of the second fin to form a sealed operating chamber where rotation of the said first rotor and the said rotor causes displacement of fluid in the sealed operating chamber a finite range of rotation.

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32. The device as recited in claim 31 where the number of legs of the inner rotor is defined by a variable  $n$  and the number of chambers defined by the plurality of fins is defined by  $m$  where  $n, m, r_i, r_o$  are defined by the equation  $n / m = r_i / r_o$ .

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33. The device as recited in claim 32 where a plurality of inner rotors are employed and the fluid entrance system further comprises a duct to communicate with the each chamber region of the said outer rotor that rotationally precedes the sealed chamber region of each inner rotor.

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34. The device as recited in claim 33 where the sum radial force upon the outer rotor is substantially balanced.

35. The device as recited in claim 33 where the central region of the outer rotor has a drive shaft attached thereto.

20 36. The device as recited in claim 32 where ratio of  $r_i / r_o$  is less than  $\frac{1}{2}$ .

37. The device as recited in claim 36 where ratio of  $r_i / r_o$  is an integer value.

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